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SCIENCE OF ELECTROPLATING

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VOL. XVIII SEPTEMBER, 1931 No. 9

EDITORIAL

EDUCATIONAL PAPERS

In reviewing the list of speakers at the Educational sessions during the Rochester convention, it was noticeable that with only a few exceptions the men who read papers were for the most part technically trained and were not actively engaged in the real work of taking charge of plating and finishing departments. It is a splendid tribute to the A. E. S. to have such men keenly interested in the growth and development of our organization. A great amount of study and research is necessary in the preparation of the papers presented, and we would be ungrateful indeed if we showed any lack of appreciation for such unselfish service.

However, there is a possibility that we are neglecting to use the practical men who have the everyday plating-room problems to solve, in our educational sessions, and their loss is being felt more and more at each convention. In nearly every branch we have men who are capable of presenting interesting and instructive papers, and who are willing and anxious that their knowledge of different problems should be imparted to others. Members such as these should be used even if the branch societies found it necessary to pay whatever expense might be involved in having them attend our annual meetings.

The discussions following the readings of the various papers were not all that could be desired this year. The weather conditions had a

rather overcoming effect on the members who attended, and no doubt this was a contributing cause to the silence maintained by many who are usually anxious for debate. As we prepare for the 1932 convention in Philadelphia let us have a continuation of the papers by the men who are trained along technical lines, also we must have the assistance of the men who for years have been training themselves in the great school of practical experience and whose help is an absolute necessity to the further advancement of our organization. With a combination such as this, we need have no fear of dissension within our ranks nor fear what critics may say.

The success of our Society has been in a great measure due to the realization that no man lives unto himself, our policies and conduct of affairs have been of inestimable value to our fellows the world over and the spirit of the Golden Rule still prevails in our organization.

BUREAU OF EDUCATION

For the branches anticipating starting classes this fall, the Bureau will have ready for distribution mimeographed copies of analyses of the following solutions: Nickel, cyanide copper, chromic acid and gold.

These analyses have been taken from Blum and Hogaboom's book and include the preparation of standard solutions. Each set is complete in itself and arranged in minute detailed operations. The forms as prepared have been tried out in Philadelphia and corrections made as experience deemed necessary.

It is hoped that anyone with but a superficial knowledge of chemistry can conduct a class with these sheets. Since fifty per cent of the branches have classes, it should not be hard to organize the balance this year.

In order to defray the expense of mimeographing it will be necessary to charge ten cents a set. A set means the analysis of one solution. If the scheme works out, the money can be used to print forms for other solutions.

Branches or classes can order copies from the Bureau in any manner they choose.

AL. HIRSCH, *Chairman of Bureau.*

PRESIDENT'S LETTER

With the arrival of the September MONTHLY REVIEW, the vacation season is practically over, and our attention is again concentrated on business and other matters relating thereto.

With that in mind, I think it might be of interest to explain some of the work now being carried on by our Society. In my opinion, the most important function at present is the research work being done at the Bureau of Standards at Washington.

Approximately 7,000 specimens of metal are being plated under commercial conditions, but complete data of each specimen is taken so that the results may be reproduced at any time by any plater in his own plant. When these 7,000 pieces are finished, which will be about November, they will be distributed to different sections of the country and exposed on the racks of the American Society for Testing Materials, who are coöperating with us in this research. Periodical inspection of these specimens will be made by a joint committee of the A. E. S. and the A. S. T. M. When these exposure tests are completed, which will probably take about one year, and the results carefully tabulated, we will have an invaluable source of data for specifying as to just how and under what conditions a certain article must be plated to stand up under certain conditions and give a definite service. In other words, the plater will be able to tell his firm just what thickness or the most economical plate to put on a certain class of work in order that it may stand up under the conditions of corrosion and wear as intended. This research work is of such a magnitude and importance to our profession that each and every member should give his utmost support and encouragement to the Research Committee so that this great work may be brought to a successful conclusion.

Another important function of our Society is being taken care of by the Educational Bureau. Their work consists of establishing chemical classes, building up a staff of speakers, and in general endeavoring to give all of us more information along scientific and technical lines so that we may keep up with the advancements made from time to time.

Now a few suggestions as to what the branches should follow up for the coming season. First, thoroughly organize your branch by encouraging all members to attend the meetings, encourage other platers to join, but make quality your aim, not quantity, put men on

your committees who are best qualified for such work. Build up chemical classes. You may have had one last year and gone through the simple analysis, but that is no reason for not continuing again this year. There is a lot more to know about the science of plating, and the more you know the more enlightened will be your labors and the higher esteem you will have of your profession. Encourage your own members to write and read papers at all meetings. Invite men of scientific and technical knowledge to your meetings to give papers or speak on subjects allied to your own interests. Not only chemists, but physicists, electrical engineers and metallurgists, have a great deal in common with us, and very often a viewpoint of a specialist in another field will prove of great interest and value. If these suggestions are followed, I am sure that we will be fulfilling the purpose of our Society by making some advancement in the science of electro-plating.

Very truly yours,

PHILIP SIEVERING.

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*FURTHER DEVELOPMENTS ON LOW pH NICKEL PLATING

By W. H. Phillips

Read at Rochester Convention, 1931

Gentlemen, some time ago I presented a paper on low pH before this Society. Since that time there have been a few further developments, and I would just like to bring you all up to date, from a more or less practical standpoint.

We have had considerable experience in running the low pH bath. We have about 60,000 gallons in operation in the General Motors Corporation, and there is probably a like amount outside of the General Motors in the Detroit district. Outside of the district I don't know just really what has been done.

One of the first things that was rather interesting as we went into the development was a series of tasks that we really made to find out what distribution of copper and nickel we should make if we were going to make the deposit .001" thick. So we tried a different series of those tasks, and these were the panels here.

*American Electrochemical Society, Birmingham, Ala., meeting.

Now, in the first case, these are nickel only. There is a thousandth of nickel. The ones right here have a pH of 2.5, and these a pH of 5.8, and these (indicating) a pH of 2.5.

I am going to pass these around, and you will notice that the low pH panels, for some peculiar reason, turned out the best. We sent those panels down to Florida for thirty days, and then exposed them for 200 days on the roof of the Research Building in Detroit, so they have had quite an exposure.

In the next group, we have a different distribution. Nickel is one-quarter of a thousandth; copper, seventy-five hundredths of a thousandth. And again, the low pH panels, as I say, for some unexplained reason, come out the best.

In all cases, the chromium is the same; it is two ten-thousandths. We don't know whether we should conclude or not that the low pH gives better protection, but that is what those panels would indicate.

Now, another thing that may prove interesting was the fact that it was supposed that the low pH produced a harder deposit, so we made some micro-character tests to determine if that was so. We found it was so. Micro-character readings are pretty hard to make, but these were about as important as any bunch we could get. In the first case, we used a temperature of 130° F. all the way through, and we varied the pH, beginning at the top, 6, 5, 4, 3, 2. I will read these:

pH	*Micro-character reading*
6.0	8.3
5.0	8.66
4.0	7.16
3.0	7.98
2.0	8.28

Now, in the case of temperature, we took a pH of 5.

Temperature (F.)	*Micro-character reading*
100	6.54
125	6.90
150	7.56
175	9.65

Now, you appreciate the increase in those readings indicates increased softness. The scratch is wider. So that the temperature at 5 pH made a tremendous difference in the softness. The high temperature produced the soft nickel. We tried the same thing at 2 pH, with the following results:

Temperature (F.)	*Micro-character reading*
100	5.64
125	6.46
150	9.38
175	10.61

Before anybody else tries to flag me, I will say that there is a discrepancy right there, because at 150° in the previous table we got 7.6, and down here we got 9.38. Nevertheless, we simply attribute that to experimental error. And I may say that these are average readings. As we print the paper, we are going to give all the results, and you can make all your own averages, if you want to.

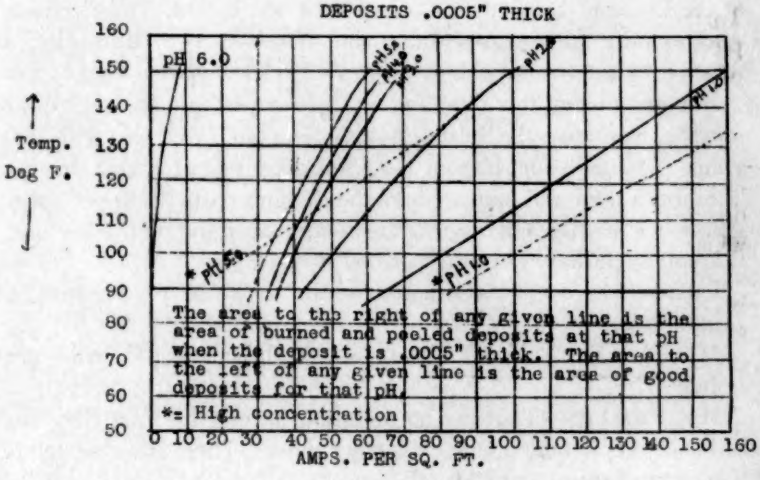
Now, I may say, as I do in the paper, that this question of hardness, from the buffer's standpoint, is usually a question of roughness. It isn't hardness at all. If the plate is smooth, the buffer pronounces it soft. If it is rough, he will pronounce it hard. So that these micro-character tests don't mean that if you get a scratch at 9.7 the buffer is going to come in and pat you on the back for making a nice plate. He may come in and tell you that it is awful hard. If it is rough, it will be hard for him to buff. The point in that is that you have got to be awfully careful, running at these high rates of speed that the low pH and high concentrations make possible, to keep the work smooth. I think bagged anodes are an awfully good thing. They seem to help. Anything that keeps the solution clean seems to be a good thing. Proper filtration is another good point, and of course, as I pointed out in the original paper, at 3 pH or lower the solution is clear.

Now, it became a question, almost immediately after the publication of this paper, whether or not you couldn't get the same results by increasing the concentration of the nickel salts. So we prepared some test runs, using 400 grams per liter of single nickel salts, against some 250 which we had used in our original experiments. We found out we did get quite a spread. Now, here are the original curves at 250 grams per liter. Here is 6 pH, 5, 4, 3, 2 and 1. Now, understand, all the good plates are over on the left side.

In our concentrated bath 5 pH came way over here (indicating left side) that is, 400 grams per liter. But it went way over here (to the right), meaning that you have got that area to work in, which is greater than 5 pH there is. There is more area on that side. However, you will notice the effect of temperature there. We tried down there at 90; the high concentrated bath doesn't work as well

as the low one does at 90. But as you go over here, and get to 110, conditions reverse, and keep right on doing that.

Now, if you take 1 pH in the high concentrated bath, well, you just have almost all the area there is. It takes in most plants. And that gives you a choice there of operating conditions.



I may say that these charts are simply proven by these panels. I would be glad to have anyone, or all of you, examine these at your leisure. You can see that we didn't make up the figures, because we have the panels from which we took them.

Now I am just going to say a few words regarding the tactics that might be used in picking out which of those baths you might use for a particular job. There are advantages on both sides. One of the advantages of the high concentration, relatively high pH,—that is, you don't want to go too high even with the concentrated bath if you want to plate rapidly. If you are willing to plate slowly, around 10 amperes or thereabouts per square foot, all right; go on up. If you want to plate rapidly, 5 is about the first place, or 5.5, that you would want to choose, probably. You have more throwing power in that bath than you have in the lower concentration, lower pH bath. So that in certain objects you might want to sacrifice certain of the conditions or certain of the advantages that you would have the other way. You can, however, get a pretty satisfactory throw for most pieces in the 250 gram per liter bath, and as low as

1 pH. The Cadillac Motor Company are plating practically all the pieces they put on the car through a conveyor tank under conditions of that kind. In checking their bath just before I came on, I found it below 1.5 pH. One of the reasons they can do that is that it is a large conveyor tank, where the electrode distances are great, which somewhat overcomes the lack of throwing power. That is also true at the Oakland Motor Car Co., but to a less extent. The electrode distances are not so great there, and they have two baths, one of which is run at about 3 pH, and the other in the neighborhood of 1.5.

But just to sum this thing up, on the low pH, you have the clear solution, you have the relatively light dragout (you see, with 400 grams per liter your dragout is appreciable. I figured that on, for instance, a thousand bumper bars the dragout costs $1.50 per thousand more for the high concentrated bath than it did on the low one. But you might have advantages to offset it.)

I think that covers the situation, as far as we have gone with it. (Applause.)

MR. MCKAY: I would like to ask if these low pH baths are agitated.

MR. PHILLIPS: There is no agitation beyond the fact they are run in conveyor tanks, where the work moves. There is no air agitation or mechanical agitation otherwise.

MR. MCKAY: Do you see any application of this low pH solution to the average job shop?

MR. PHILLIPS: I may say in the city of Detroit that there is one large job shop operating on low pH; another one going to it immediately.

MR. J. H. FEELEY: A job shop, might I ask, that is on production?

MR. PHILLIPS: Yes.

MR. FEELEY: In a small job shop, under normal conditions, do you think high pH is better?

MR. PHILLIPS: No. And I'll tell you why I don't. It is very difficult to get the heavy plates we are demanding now. Speaking for the General Motors Corporation, we are asking for a thousandth of combined copper and nickel. Now, just try and get it with a high pH bath. It is pretty hard to do, unless you have a concentrated bath. It can be done, but it is rather difficult.

MR. FEELEY: In a production shop time, of course, would be a factor. But in the small shop, where time is not a factor so much, I

don't see any objection to getting it with a high concentrated bath and high pH. We are getting it.

MR. PHILLIPS: I have no objection if you have the time, but that is what most people don't have.

MR. MCKAY: How long does it take to deposit a thousandth with this low pH bath?

MR. PHILLIPS: Well, you can, if you want to use this extreme as we have it here (on diagram), you can take 130 amperes per square foot. That would go pretty fast.

MR. FEELEY: About twelve minutes.

MR. GEO. HOGABOOM: About eight minutes.

MR. MCKAY: What voltage do you operate at, under those conditions?

MR. PHILLIPS: That, again, would depend on your electrode distance, you see. But I would say that an electrode distance that would plate the ordinary articles at 130° would probably be somewhere around ten or twelve volts. Of course, if you have nice flat objects, you can put up close, then you can cut that way down.

MR. OSCAR SERVIS: Do you have any difficulty with pitting at the various temperatures more or less, and how do you overcome it?

MR. PHILLIPS: Everybody has difficulty with pitting with nickel solutions, even the Bureau of Standards.

MR. SERVIS: I mean, for instance, at 75 degrees Fahrenheit, or 150 degrees Fahrenheit.

MR. PHILLIPS: That is a very fair question, Mr. Servis. There is difficulty with pitting, but there isn't any more difficulty with low pH than there is with high pH, and it is coming and going, it is just unexplained. For instance, we thought when we first started our low pH work commercially, that it accentuated pitting conditions in the beginning. If we added enough peroxide to overcome it then, we thought we wouldn't have so much later on. Well, then, we went, I believe it was to the Frigidaire Plant. Mr. Wirshing went down there and started a bath, and he had his peroxide barrel right up close to use, and he never used a drop. The thing started off and didn't pit at all. So that I really don't know personally what makes one solution pit and another one not pit, but I do know from rather extended experience with this low pH you don't have to add any more peroxide than you do at the high pH.

MR. SIEVERING: I would like to ask whether that is a single salt solution you are speaking of.

MR. PHILLIPS: Yes.

DR. BLUM: High chloride?

MR. PHILLIPS: Reasonably so. We had 30 grams per liter in that high concentrated bath, and 15 in the normal bath.

MR. MCGARVEY: What happens when you use about five or six volts with this? Do you get any results at all?

MR. PHILLIPS: Oh, yes. A great many of them are operated at about five or six volts. It is possible to get up to possibly thirty amperes or more at that voltage, and that is reasonably fast. You know, we are likely to talk about 30 amperes per square foot in a slighting way, but there aren't so many plants over 30 amperes per square foot. Most of them use way under that.

MR. P. C. STRAUSSER: In making up a new nickel solution, you do not purify that solution, that is, remove your iron and zinc and so on?—You just use your salt as it comes?

MR. PHILLIPS: We have used the chemicals just as they came. We suspect that therein lies the difficulty on the pitting, but we don't know.

MR. C. F. NIXON: I was wondering whether or not you had any more light to shed on the use of sodium chloride as opposed to nickel chloride in the low pH bath.

MR. PHILLIPS: I regret to say I haven't. The question of sodium chloride, or nickel chloride, is one of those things that we haven't had a chance to research on, for the simple reason that the total cost for the Corporation, on what we use, is hardly enough to pay for the research. Now, possibly later on, the Bureau of Standards might take that up and do it for the whole country, and it would be a real item. But with our corporation we just couldn't afford it.

DR. BLUM: I would just like to comment, not especially to ask a question on this thing, but to show the difference in the situation in plating which is illustrated most emphatically by this solution, but which applies as well to other plating solutions.

It is safe to say that the average conception of the electro-plater some years ago was that success in plating depended on the formula of the solution that you used. Now, these results, and all that is connected with them, show that it doesn't depend nearly so much on the formula of the solution used as the conditions under which you use it. You can have the best solution in the world and yet poor deposits, and you can have a relatively poor solution and get good deposits, simply meaning that the whole success, particularly on production

plating, to meet rigid requirements, depends not simply on making up a certain solution, saying that is the formula and we are through now, but depends on keeping all the conditions, temperature, current density, pH and purity, all maintained in order to get satisfactory results.

The point that I want to emphasize is that plating is a whole lot harder, but probably more interesting than most platers thought ten years ago, because then they were apt to swear by a certain solution and say if they made up a certain formula that that was all that there was to the problem. But I think that we have gone a long way beyond that now.

FOREMEN PLATERS INDISPENSABLE

Electro-plating shops, small and large, have awakened to the need for and the value of chemical analysis for controlling solutions. The unremitting efforts of the American Electro-Platers Society, aided by the Bureau of Standards, have borne fruit to such an extent that no progressive plating shop nowadays takes its solutions for granted, but has periodic analyses made regularly. There are now, moreover, a number of electro-plating experts with experience and training in methods of analysis who serve plating shops too small to support chemical laboratories of their own.

This is, of course, all to the good. It shows that the plating industry is keeping in step with the times. But a rather strange by-product has accompanied this development. We are told of some expert analysts who, in their offers to keep solutions in condition, make the statement that their work eliminates the need for foremen platers; that all the shop needs is boys or girls to rack the work and remove it from the tanks.

No words can be too strong in denying and refuting such claims. Chemical analysis is an indispensable aid to good electro-plating, but chemical analysis alone can never replace the skilled, practical electro-plater. No matter how good the consultant may be, his weekly or bi-weekly visits are utterly insufficient to keep a plant in shape, to check the work as it goes into the tanks and follow it through as it comes out. In some cases, work done without the aid of a practical plater may look well and may even pass muster for a

while. But without the experienced hand and practiced eye of the practical plater, there is no certainty that the coating is sufficient. There are many things that can happen between the visits of the expert, and every manufacturer knows how expensive it is to have work returned to be stripped and replated.

EVENING COURSE IN ELECTRO-PLATING AT NEW YORK CITY COLLEGE

The course in practical electro-plating at the College of the City of New York starts a new class on September the 28th under the personal direction of Dr. L. C. Pan. It is open to all persons interested in electro-plating, metal finishing and chemical control of plating solutions. The class will meet on Mondays and Wednesdays from 7 p.m. to 11 p.m. in the Chemistry Building, Amsterdam Avenue, at 139th Street, New York City.

The subjects covered by the course are as follows:

1. Fundamental principles underlying the various operations of modern electro-plating.

2. A critical study of present-day practice in electro-plating of various metals and alloys, including copper, nickel, chromium, cadmium, zinc, brass, iron, lead, tin, silver, gold, platinum and rhodium.

3. Physical and chemical methods of control, including simplified methods of analysis and preparation of standard reagents.

Laboratory work constitutes an important part of the course. Among the exercises to be done in the laboratory are the Faraday's law, current efficiency, determining thickness of deposit, electrode potentials, polarization and depolarizers, metal, metal-ion and hydrogen-ion concentrations, buffers, brighteners, throwing power, porosity and corrosion tests, and analysis of plating solutions. The laboratory work is arranged flexibly so as to meet the individual needs of each student.

Registration may now be made evenings in person or by mailing a check or money order for $37.50, payable to the College of the City of New York, attention of Evening Session, Room 100, Main Building, 140th Street and Convent Avenue, New York City.

THE USE OF THE COMPENSATING COLORIMETER IN THE ELECTRO-PLATING INDUSTRY

By Theo. J. Zak

Read at Rochester Convention, 1931

According to Dr. Yoe, of the University of Virginia, it has long been the custom of chemists to classify different methods of analysis according to the technique employed,—for example, gravimetric analysis and volumetric analysis. However, if we classify the methods according to the physico-chemical principles involved, it will be found that practically all quantitative procedures may be grouped under one of the following principles:

1. Neutralization.
2. Solubility-product.
3. Oxidation-reduction.
4. Evolution and measurement of gases.
5. Colorimetry.

The basis of colorimetry may be stated as follows:

When equal heights of two solutions give the same intensity of color, the concentrations are said to be equal; or when using the compensating colorimeter, equal color intensity is obtained from different heights of two solutions, then the concentrations are inversely proportional to the heights, which in reality is Beers' Law and holds true for most colored liquids.

Some of the nickel plating establishments use a number of tanks, each tank perhaps for its own particular class of work. Usually, it is very essential that the current density, pH, and nickel content be checked very closely. The current density can be checked by the use of an ammeter, but a chemical method must be resorted to for the pH and nickel content. The laboratory is able to check the nickel content by the gravimetric dimethyl-gloxime method or volumetric cyanide, but this often takes a long time when standard solutions have to be prepared.

The compensating colorimeter can be used to determine both the pH of the solution and the nickel content. This instrument makes use of the balancing principle for determining a substance colorimetrically; that is, an unknown sample is made to match a standard sample by lengthening or shortening the column depth of a liquid. This is the most rapid and most accurate of all colorimetric methods.

First, I shall attempt to give you some idea, along with a diagrammatic sketch, of the design of the Bausch & Lomb compensating

colorimeter, which is the instrument that was used. The instrument employs a prism system which consists of the two rhomboid prisms (E) and the bi-prism (F). The system is completely symmetrical with respect to light transmission, all silvered or cemented surfaces having been avoided. The dividing line of the photometric field is the edge of the bi-prism (F). This edge is protected by a cover glass (G) and it is viewed with an eyepiece consisting of lenses (H-H) with an eye point diaphragm at (I). (D-D) are two hollow plungers. The bases of these plungers are fused so that it is impossible to injure them by the use of any solvent. The plungers dip into flare top cups (C-C), which are also of the fused base type. These cups are separately movable and are each provided with a millimeter scale. These cups (C-C) in turn dip into large cylindrical cups (B-B). The cups (B-B) together with the auxiliary substage cups (A-A) are movable by rack and pinion as a single unit and are also provided with a millimeter scale and vernier. The cups (A-A) are the auxiliary cups used when body color intervenes, as, for example, in nickel plating baths.

Before discussing the use of this instrument for the pH determination, I will attempt to explain the meaning of hydrogen concentration, and its importance to the plater. According to Messrs. Blum and Hogaboom, the first and most important effect of hydrogen ion concentration is its relation to the structure of the deposit as a whole. The presence of excessive acidity causes a hard, brittle and cracked deposit, while a solution of high pH causes a soft, blue, hazy deposit similar to one where a high current is used. However, it has been reported recently that good results were obtained from solutions of low pH.

A thorough understanding should be had of the concentration of acid present in the solution as determined by titration and the acidity or its total hydrogen ion concentration. The first is the measure of quantity, while the hydrogen ion concentration is the measure of intensity. In metal deposition, the hydrogen ion concentration is more important than the acid content.

According to the theory of electrolytic dissociation, in all water solutions the dissolved substance is partially broken up or becomes dissociated into positive and negative ions or the solution contains free $H+$ and $OH-$ ions. When the number of $H+$ ions exactly equals the number of $OH-$ ions, the solution is said to be neutral.

Before convenient means for determining pH were available, the chemist relied upon titration methods. If he was dealing with an acid solution, he carefully added alkali of a known concentration until the solution was neutral. It was then possible to calculate the amount of acid present in the original solution. The percent of acid or alkali, however, does not give a true picture of the existing chemical conditions of a solution, because two solutions made up of different acids may require the same amount of alkali to neutralize them and yet give widely different pH values.

Griffin, in his work "Technical Chemical Analysis," gives the following definition:

"The hydrogen ion concentration of liquids or dilute solutions is an expression of the intensity factor of acid or alkaline properties as opposed to the quantity factors 'acidity' and 'alkalinity'."

A solution normal in hydrogen ions will contain in each liter one (1) gram of hydrogen ions. However, in a weak acid solution such as in nickel deposition, it would be inconvenient to refer to H+ equals 0.0001 N. So Sorensen adopted the symbol pH. pH is equal to the log of the reciprocal of the hydrogen ion concentration:

$$pH = \log \frac{1}{H+}$$

The principle of making pH measurements colorimetrically is based on the fact that various indicators change in color when they are acted upon by solutions of different acidities or alkalinities. I shall now explain how the pH of a nickel plating solution is obtained with the hydrogen ion colorimeter. Into two beakers measure fifteen (15) cc. of distilled water, and into a third beaker measure fifteen (15) cc. of a nickel of which the pH is desired. Now to all beakers add 0.2 cc. of brom cresol purple. This is made up from the sodium salt of 0.04% strength. It is essential that all three beakers contain the same amount of indicator. To one of the beakers containing water add two or three drops of acid buffer. The indicator will now be completely converted to the acid form. To the second beaker of water add two or three drops of alkali. This indicator will now be converted to the alkaline form.

The sample solution to which the indicator has been added is used to fill one of the auxiliary cups (A) and is placed on the left side of the instrument. The other auxiliary cup is filled with the original

sample solution and placed on the right side of the instrument. The body color of the liquid is now present on the two sides of the instrument in equal amounts.

The weak acid solution which has turned the indicator to the characteristic acid color is placed in a flare top cup (C) and inserted in the right side of the instrument. The weak alkaline solution which has turned the indicator to its characteristic alkaline color is placed in the cylindrical cup (B) on the right side of the instrument. The remaining cups are filled with water for optical continuity of the medium.

The fixed depth of cups (A-A) indicates the setting for cups (B-B) which move together. The setting of cups (B-B) in turn limits the movement of cup (C). Thus if the depths of (A-A) are 15 mm., then (B-B) are set at 15 mm., and hence mechanically the total movement of (C) is 15 mm.

It will be seen that by moving (C) on the acid side, the combined depth of acid and alkaline colors remains the same but their ratio is changed. It is thus possible to match the two fields exactly. After the two fields are matched, read the (C) scale on the left-hand side. The pH may be read from the tables or calculated from the equations.

The equation for pH is as follows:

$$pH = pKa + \log \frac{\text{alkaline form}}{\text{acid form}}$$

If the large cup (B) containing the alkaline form of the indicator is set at 15 mm. depth on the scale and the color match is obtained when cup (C) containing the acid form is at 10 mm., then the ratio is:

$$\frac{\text{alkaline form}}{\text{acid form}} = \frac{15 - 10}{10}$$

Substituting this value in the equation:

$$pH = pKa + \log \frac{15 - 10}{10}$$

The pKa is the symbol for the apparent dissociation constant of the indicator. This value is expressed in terms of pH and is different for each indicator. It may be thought of as that point on the pH scale where the color of that particular indicator is a half-and-half combination of its alkaline and acid colors. It serves as a numerical reference point from which the ratio of acid color to alkaline color is calculated. The pKa value of brom cresol purple is 6.30, according to Clark. At the present day there is considerable discrepancy as to the true and correct pKa value of various indicators. La Motte gives the pKa value of brom cresol purple as 6.2, Hastings lists it at 6.37 where the ionic strength is 0.097 and 6.17 where the ionic strength is 0.416. Kolthoff gives it at 6.4 at zero ionic strength and 5.9 at 0.5 ionic strength. The chief reason for these discrepancies seems to be in the ionic strength of the solution. The ionic strength of the solution is obtained by multiplying the concentration of each ion by the square of that ion's valance number, summing all these products and dividing the result by two. It should be evident from these figures that that pH value derived from any one of the pKa values will show certain discrepancies when compared with the hydrogen electrode.

About a year ago, a study was made in our laboratories by Dr. Line of the University of Rochester and myself on the comparison of the hydrogen ion colorimeter with the hydrogen and quinhydrone electrodes for determining pH both in colorless buffered solutions and also nickel plating solutions. The colorless buffered solutions were phthalate and phosphate mixtures prepared according to the directions of Clark and Lubs, and ranged from a pH of 1.8 to about 9.0.

Table I gives the pH values of a series of colorless buffered solutions measured with the three instruments listed above. Taking the measurements with the hydrogen electrode as a standard, the deviations of the other two instruments from this standard have been calculated. Several points were checked with the colorimeter using two different indicators. The values obtained with each indicator are shown in the table. At the bottom of the table will be found the average and the maximum deviations from the hydrogen electrode values for each instrument as determined with this series of buffered solutions.

Attention is directed to the following points: In the pH range from about 3 to 7 the colorimeter and quinhydrone check each other

and the hydrogen electrode satisfactorily. Below 3 and above 7 the deviations are much greater, being larger for the colorimeter and smaller for the quinhydrone electrode.

The two solutions of pH values 1.81 and 2.57, for example, were poorly buffered. Very slight changes in molar concentrations will have a distinct effect upon the results. The relatively large deviations in the upper range are probably due to the higher ionic strength and to the salt effects upon the indicators. The average deviation obtained with the quinhydrone from the hydrogen electrode was 0.07 pH units; and the average deviation with the colorimeter method was 0.17 pH units. Again the maximum deviations with the quinhydrone electrode was 0.15 pH units, and with the colorimeter 0.40 pH units.

TABLE I

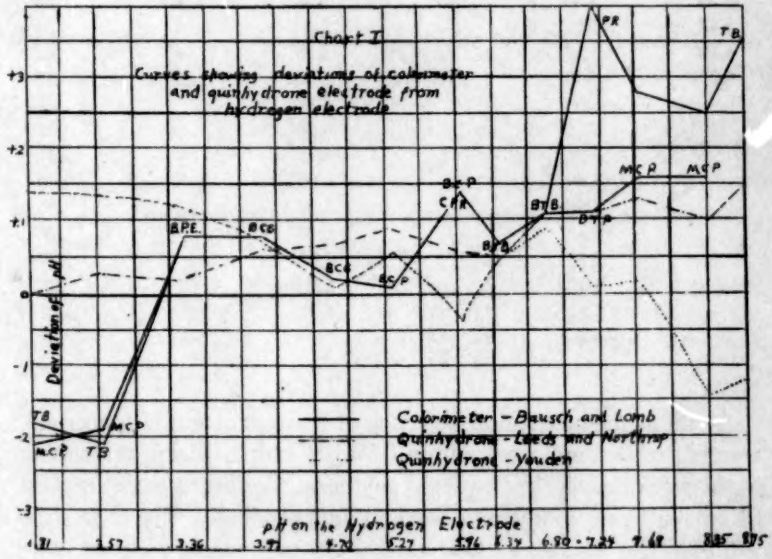
pH VALUES OF COLORLESS BUFFER SOLUTIONS

Hydrogen Electrode	*Quinhydrone Electrode*		*Colorimeter*		
pH	pH	Deviation from pH	pH	Deviation from H	Indicator
1.81	1.81	.00	1.60	—.21	M. C. P.
			1.63	—.18	T. B.
2.57	2.60	.03	2.38	—.19	M. C. P.
			2.36	—.21	T. B.
3.36	3.38	.02	3.44	.08	B. P. B.
3.97	4.03	.06	4.05	.08	B. C. G.
4.70	4.77	.07	4.72	.02	B. C. G.
5.27	5.36	.09	5.28	.01	B. C. P.
5.96	6.02	.06	6.10	.14	C. P. R.
			6.10	.14	B. C. G.
6.34	6.39	.05	6.41	.07	B. T. B.
6.80	6.91	.11	6.91	.11	B. T. B.
7.24	7.35	.11	7.35	.11	B. T. B.
			7.64	.40	P. R.
7.68	7.81	.13	7.84	.16	M. C. P.
			7.96	.28	P. R.
8.35	8.45	.10	8.51	.16	M. C. P.
			8.60	.25	T. B.
8.75	8.90	.15	9.13	.38	T. B.
Average Deviation		.07		.17	
Maximum Deviation		.15		.40	

Now I shall go over to the nickel plating solutions. Samples were taken on several successive days from the nickel plating tanks in the factory and the results were tabulated. The pH values of nickel

plating solutions obtained with the colorimeter are uniformly higher than those obtained with the quinhydrone and hydrogen electrode. Dr. Blum has called attention to this fact, stating that the colorimetric values may be as much as 0.5 pH units higher than the hydrogen electrode.

I wish to offer this suggestion why the colorimetric readings are higher than those obtained with the hydrogen electrode in nickel plating baths. You will recall that, using brom cresol purple, the deviation on colorless buffered solutions was only 0.01 pH units,



while in nickel plating solution the average deviation was 0.42 pH units. Now the colorless buffered solutions were of low ionic strength as compared with the ordinary nickel plating solutions. Sendroy and Hastings have pointed out the pKa values of indicators are a function of the ionic strength of the solution, and if you increase the ionic strength you decrease the pKa. It not only depends upon the ionic strength of the solution, but on the type of ions present. Magnesium sulfate has a tendency to lower the pKa value of solutions; therefore, if the pKa value of brom cresol purple is determined for a specific nickel plating solution, then one would expect colorimetric readings will check with the hydrogen electrode within the limits of experimental error.

TABLE II

pH VALUES OF NICKEL PLATING SOLUTIONS

Hydrogen Electrode pH	*Quinhydrone Electrode* pH	*Colorimeter* Deviation from H	pH	Deviation from H	Deviation from L-N
5.51	5.60	.11	5.92	.39	.32
5.42	5.51	.09	5.86	.44	.34
5.38	5.46	.08	5.77	.39	.31
6.20	6.37	.17	6.57	.37	.20
5.39	5.60	.21	5.92	.43	.32
5.42	5.55	.13	5.89	.47	.34
5.40	5.52	.12	5.85	.45	.33
6.20	6.40	.20	6.58	.38	.18
	5.59		5.86		.27
	5.65		6.00		.35
	5.86		6.17		.31
	5.69		6.09		.40
	5.58		5.94		.36
	5.62		6.00		.28
	5.56		5.95		.29
	5.48		5.86		.38
	5.54		5.91		.37
Average Deviation		.14		.42	.32

As far as the mechanical accuracy of the instrument is concerned, results can be duplicated within 0.03 pH units. During the course of the work on colorless buffered solutions, the results were checked by two different individuals working independently. The next slide will give you an idea of how closely the two people checked. The average deviation of these two was two (2) parts per hundred (100) or 0.02 pH.

After one gets accustomed to the workings of the instrument, both pH and nickel content can be determined quite rapidly and accurately as compared with other methods. Another advantage is that the instrument is independent of daylight. The lighting source can be a colorimeter lamp, such as the one on the table, and pH measurements may be made either in the daytime or at night.

We have found this instrument to be the most accurate device for measuring colorimetrically pH because it includes the desirable features of adjacent photometric fields, accurate scales, and is independent of standards.

TABLE III

OBSERVATIONS BETWEEN TWO OBSERVERS ON THE COLORIMETER

No. 1	*No. 2*	*Difference*
1.44	1.42	.02
2.35	2.36	.01
3.41	3.46	.05
4.05	4.04	.01
4.70	4.73	.03
5.30	5.25	.05
6.10	6.10	.00
6.40	6.41	.01
6.90	6.92	.02
7.57	7.56	.01
8.62	8.60	.02
9.09	9.08	.01

Average Deviation—2 parts per hundred or 0.02 pH

Now just a few words about determining nickel content of plating baths with this instrument. In determining nickel content only the flare cups are used. The resulting ratio gives the content of the unknown directly in ounces per gallon. The best standard to use is a nickel plating solution which has been accurately analyzed. First, you filter the standard and sample, and then fill one of the flare cups with the standard and the other with the unknown. Place the standard on the left side of the instrument, say at 10 mm., and the unknown on the right. Balance the two fields and read the unknown's scale.

For example, if the known sample contains 4 ounces of nickel per gallon and is set at 10 mm., and the unknown sample reads 13.3 mm., the nickel content of the unknown is equal to:

$$X = \frac{10 \times 4}{13.3} = 3 \text{ ounces per gallon}$$

for according to Beers' Law the concentrations are inversely proportional to the heights.

The information given in this paper has been obtained during several years of routine control of plating solutions at the Bausch & Lomb plant.

Assistance from Mr. E. S. Bissell of the Scientific Bureau and other members of the Chemical Laboratory in collecting data is gratefully acknowledged.

It is highly probable that the instrument is applicable to other plating solutions where control is imperative—such as chromium or copper. We are at present working on these problems, and information will be offered as soon as reliable methods are developed so that dependable results may be obtained.

It is not always feasible for the electro-plater in the shop to do his own analytical work. He may be busy with routine. He may have to keep close watch on his helpers and the men under him. He has mechanical and electrical equipment and connections to watch. He must, in many cases, specify and even design the racks for special work. Given good assistance, he can and does find time to analyze his solutions, but where it is not possible, it is perfectly legitimate to call in outside help for this type of work. But it is a delusion, dangerous and expensive, to think that periodic visits of the analyst can replace the practiced and watchful eye of the experienced man on the job. An electro-plating shop is too delicate a department to leave to inexperienced hands. In these days when the finish and appearance play such a large part in the salability of a product, and when the public demands not only appearance but wearing qualities, it is penny wise and pound foolish to the utmost degree to dispense with the foreman plater.

The American Electro-Platers Society has done wonderful work in educating its members to the latest and best practice in plating shop operations. It is now going forward steadily along the path of chemical analysis, the fundamentals of chemical reactions and general chemistry, all as applied to electro-plating operations. Unlike a labor union (which it is not), the American Electro-Platers Society works along the lines of educating its members in their profession, leaving salary and other financial considerations entirely to the individual. In other words, it puts them in the class of the professional or technical man. No such man can be replaced by the consultant or expert. He can be guided, helped and coöperated with, to the benefit of the organization which employs him—but not replaced.

It is a pleasure to add that there are, to our knowledge, electro-plating experts rendering service in chemical analysis who specify clearly in assuming such contracts that the plant must retain its plating foreman, who is to work with the expert. This is the ideal combination.—*Metal Industry.*

BRANCH SECRETARIES

Now that the branches are about to resume their meetings again after the Vacation Season we are asking you to send in your reports to the Editor's office by the 20th of each month.

During the past year the majority of branch Secretaries cooperated splendidly with us.

We are looking forward to a year of greater service than ever before and assure you that the reports of branch doings and papers read at local meetings have been heartily approved by our members.

Editor.

BRANCH NEWS

PHILADELPHIA BRANCH

On account of summer vacations and extreme hot weather, Philadelphia Branch does not hold regular meetings during July and August, but the officers of the Branch hold executive meetings and look after the interests of the Branch during this period.

The officers of the Branch held a meeting in July and August, and President Snyder appointed the following chairmen of committees: Geo. Long, Banquet Committee; J. J. Basch, Educational Committee; and our good friend, Past President Geo. Gehling, was appointed Director General of the Philadelphia 1932 Convention.

Philadelphia Branch, through its officers, is already at work on the convention and, depression or no depression, intends to make this convention the most instructive and best attended convention in the history of the A. E. S.

Chairman Basch of the Educational Committee expects to make things hum this winter with good speakers and good papers, and expects the members to come out and make the meetings as lively as they did last year, for the more discussion we have on the papers the more interesting the meeting, and in doing so you will be helping yourselves to keep up to date as to what is going on in the plating industry and also in Philadelphia Branch.

The next meeting will be held at the Harrison Laboratory, 34th and Spruce Streets, Philadelphia, on Sept. 11, at which time the report of the Rochester convention delegates will be heard, and we also have been promised a moving picture of some of the high lights of the convention.

The following talk was given at the June meeting of the Branch, and while it is somewhat away from direct plating talk, it was refreshing to hear something that was different and which was very interesting to all those present.

METALS USED IN AIRPLANE CONSTRUCTION

By Mr. Thomas Lyons, of the Keystone Aircraft Co.

You are probably aware that there has been considerable progress made in aeroplane construction, in aviation in general, in the last few years. Of course, there hasn't been that phenomenal growth that has been characteristic of the automobile and radio, because, for one thing, everybody has felt that when man got up into the air he was in an unnatural element, that the air was made for the birds to fly in. But since that we have found that in flying we take advantage of natural laws, and there has been considerable progress made.

Of course, there is one fact that stands out, and that is that flying is still the fastest means of transportation, and a straight line is the shortest distance between two points. And combining the two, with a fast ship, flying between two points directly, it is rather rich in its

potentialities. Flying is smooth, is clean, comfortable, interesting, highly practical, and, strange as it may seem, it is safe. Our modern transport lines are operating every day on schedules that are just as exacting as the railroad and the steamship. Of course, the weather doesn't always warrant air travel, no more than it does the steamship lines in the heavy fog. Nor in railroads at certain times. And there is a great difference of opinion one way or the other just when a ship should fly in bad weather. I think personally that if some of these transport companies could hold back their schedule a little bit in bad weather, and not be so ambitious about it, we wouldn't read so much of these crashes that we do read of now and then in the papers. And every crash, by the way, is just one step backward for flying, because the ultimate object of everybody in the flying game is to make flying safe, and a crash due to some dispatcher's overanxiety is not helping things a bit. Of course, sooner or later, we will have instruments so perfected that blind flying will be commonplace, and we will take advantage of radio directional control and so forth.

Of course, failures from structural defects are comparatively few, and they will always happen, just the same as they have happened in automobiles, and will always happen, as long as there are people crazy enough to take chances. The same thing can be said of antique planes. The idea of safety, in fact, everybody in the industry is trying to build up this idea of safety, and reckless flying in antique planes is naturally unsafe, but modern planes today are safe. A few years ago, when they were flying ships that were aerodynamically primitive, you couldn't be condemned for saying that they weren't safe. Even in the war period, safety was considered a factor that was quite desirable, providing it didn't interfere with any of the other vital specifications, such as tactical missions on military flying and so forth.

In every form of transportation, they usually start in their construction with wood, and there has been a trend from wood to metal. In water transportation, all ships and boats were of wood construction prior to the Civil War. Today there are still wooden ships, but they are relatively few and small. In rail transportation there is an increasing amount of metal. In water and rail transportation a transition has taken and is taking place. In the aircraft industry as well. Designs were changing so swiftly during the early period of development that frequent and radical alterations became necessary

even during the construction of a plane. Large numbers of a single model were not built, but within a few months they became obsolete. Up until a few years ago wood was used almost exclusively in the construction of all planes. Wood lends itself very easily to the changing conditions of design and construction. Metal, on the other hand, requires expensive machinery, and before this can be justified quantity production must be assured. This is, of course, out of the question where just a few ships of a particular type are desired. And so far there is no particular type of plane that has been approved to such an extent that it could be put in on a production basis, because the designs change so rapidly that it wouldn't pay. And military ships have supplied most of the aircraft industry with their business for quite a few years, and of course you know in military aircraft they have to be changing the design all the time to keep them right up to the minute.

The weight/strength ratio and endurance of wood, especially against vibrational effects, make it most interesting; but wood, being a product of natural growth, is variable in its properties, and because of the high requirements demanded in aircraft structures only a small percentage of the original lumber finds its way into the finished plane. This necessarily means that the price of wood must be high, and there is no reason to believe that it will diminish any. Metal can be made to required properties within very narrow limits, —special shapes such as I beams, channels, tubings, angles, can be fabricated and assembled from metal much more readily than from wood. Wood must generally be used in compression, and tension joints are quite difficult; in many cases impossible. The low cross-grain properties also constitute a serious disadvantage. Wood readily absorbs moisture, and thus will increase in weight. Under such conditions there is a direct loss of lifting capacity. Wood is also subject to shrinking from drying out, with consequent loosening of joints. Furthermore, with absorption or loss of water content, wood warps. This may alter the shape of the structure so as to produce serious aerodynamic effects. However, the use of varnish and dope has minimized these effects, as also the ravages of insects that sometimes are found in tropical climates. They are very particular about the inspection of the wood, especially about its condition, and before the wood is assembled it is inspected for specific gravity and moisture. Of course, wood is combustible and increases the fire hazard. This will assume increasing importance with the

growth of the aircraft industry. The trend here must be, as it is in all other forms of transportation, towards non-inflammable materials.

It would be interesting to compare the physical properties of wood and aluminum alloy and steel as used in aircraft, especially in their specific gravity. Taking spruce as an example, because spruce is the wood mostly used in aircraft, it has a specific gravity of .43. Aluminum alloy, 2.8. And chrome molybdenum steel, 7.9. And against spruce,—spruce would develop a tensile strength of 4700 to about 9400 pounds per square inch. Aluminum alloy, about 60,000, after cold working and heat treating. Chrome molybdenum steel, in the normalized state, about 100,000 pounds to 200,000 pounds per square inch, in heat-treated parts.

This chrome molybdenum, S. A. E. 4130, is the steel mostly used in aircraft work, because it is capable of great strength and resistance to vibrational stresses, alternating stresses, high impact value, and can be welded into shapes, but after welding usually it has to be normalized; that is, the welding operation sets up strains, gives it coarse structure, and of course that has to be normalized. And in order to do that they heat it up to about 1600 degrees F., and, when it is soaked through, take it out and cool it in the air. 4130, so treated, will develop a tensile strength anywhere from 90,000 to 110,000 per square inch. For heavy parts, parts that require great strength, as in the landing gear, axles and so forth, we use 4130, heat treated to a tensile strength of 200,000 pounds per square inch, and wing fittings, 180,000. Special shafts and fittings, around 150,000, and most parts about 125,000. When it is heat treated to 125,000 it gives a steel that is quite ductile. Combined with that strength you can usually get a bend test of 180 degrees when it is heat treated to 125,000. Of course, you know, the strength is obtained by the draw, after the quenching operation. The steel is heated up to 1600 degrees, quenched in oil, then the structure that is obtained after that treatment leaves the steel very hard and brittle. It won't stand much alternating stress, vibrational stress, after it is quenched, but it is heated up or drawn or tempered, as you hear it called, and it depends on that drawing temperature just what the qualities of the steel are. In order to obtain steel of 200 pounds strength, it is usually drawn somewhere between 600 and 700 degrees Fahrenheit. The ductility or the elongation on 200,000 pounds usually runs about 6% to 9%. On the 150,000 specification,

the elongation, which is an index of the ductility, will run around 10%. And when heat treated to 125,000 it is usual to obtain anywhere from 15% to 23%. That is common practice. Sometimes you get higher figures, according to the analysis, but the analysis ranges around 30 carbon, 25 to 25 carbon, with 40 to 70 manganese, and 8 to 11 on chrome, and 15 to 25 molybdenum.

The fuselage, that is the body, of some ships, is fabricated from chrome molybdenum tubing. This tubing is capable of great strength, and it is heat treated to 125,000. The fittings are normalized, and after welding, of course, the ideal practice would be to normalize the whole fuselage, tubing and fittings, and everything else, but that isn't practical on a big scale, as on bombing planes, for instance, that have a wings-spread of around 72 feet, and a fuselage around 90 feet long. So the sections are designed a little heavier, and the tubing 125,000, figuring that after the welding operation they can usually depend on 100,000/95,000 tensile strength for the whole assembly.

Aluminum has a wide application in the aeronautic industry. Of course, as you know, on account of its lightness. There are aluminum alloy castings, wrought aluminum alloy, and die castings. The aluminum alloy castings have a composition,—well, it is likely to be anything. There are twenty or thirty different analyses for castings, depending on just what the designer wants, and the use to which it is going to be put. A typical analysis is about 10% copper, with about .2% magnesium, and the rest aluminum. Another one is: 1% copper, 14% silicon, and 1% magnesium. The castings are capable of developing a tensile strength of about 28,000 pounds per square inch, and a yield point of about 24,000, but they only give about 1% elongation. Naturally, you can't expect much strength in a casting of aluminum, because it is porous, usually porous, although they do some very good work. This is sometimes taken care of in castings where the castings are used in fuel lines or fittings in fuel lines and so forth, by impregnating with sodium silicate, that is, water glass, under vacuum, or even under pressure. That is, impregnating the pores of the metal with sodium silicate, and then baking it to about 200 degrees afterwards. This has been approved by the Navy Department just recently. They used to just dip them in the sodium silicate, but that didn't go over so big.

Heat treating in the castings will produce substantial improvements in cast materials of the same composition, but the maximum

improvement results only after the material has been worked sufficiently to obliterate the cast structure of the alloys. The wrought aluminum alloys, as I said, develop a pull of about 55,000 to 65,000 pounds, and a yield point of about 32,000, and the elongation on wrought aluminum alloys runs up around 21%. A typical analysis for wrought dural, or aluminum alloy, is about 4% copper, ½% manganese, and ½% magnesium. Rolled and drawn bar in size over ¾" may fall below the range of tensile strength and yield point by as much as 3,000 pounds, and the elongation by several percent.

In order to heat treat aluminum alloy, it is heated up in a salt bath composed of equal parts of sodium nitrate and potassium nitrate. That is heated up to about 930 degrees F., usually from 920 to 940, and the parts immersed in that for twenty minutes to a half hour, even an hour, depending upon the section, and they are taken out and quenched in water, cold water preferably. It doesn't make much difference about the quenching; you can take them out and let them cool in the air. But it has been found out that the parts that are quenched in water have superior corrosion resisting properties, while those quenched in air don't compare so well. Why that is, I just don't know.

And this dural, after it comes out of the quench, is soft; really, it is about half hard. And it is capable, then, of being worked, cold worked, formed and fabricated or shaped into fittings or any shape that they desire, and it begins to get hard, it hardens up, in about fifteen or twenty minutes. So you can see that while it is soft it gives them a chance to fabricate it; it will reach its maximum hardness in about three or four days. Sometimes it takes about ten days. We give it ten days to make sure. But most of it comes up in one day, up to about 60,000 tensile strength, and they go ahead with it. The rivets, the frames and beams and so forth are heated in this manner, and they are taken out of the bath and put in a container that is kept cold by dry ice. Now, they will keep soft indefinitely, or at least for a few hours, and long enough for the men to drive them up cold. And after they are driven up they begin to age, and they reach their maximum hardness in a few hours. That is quite an advantage in using dural rivets, inasmuch as they can drive them cold, without any distortion of the metal itself. The aluminum alloy, after it is heat treated, and the surface is usually prepared before it is assembled, it is painted, but before it is painted it is given the anodiz-

ing treatment. There are a number of ways to prepare the alloy before it is painted. It can be etched with caustic soda, it can be cleaned with benzol, it can be sand blasted, but it seems that the Army and Navy specifications call for the anodizing process, which, of course you know, is passing a controlled electric current through the work, immersed in 3% chromic acid. The work is made the anode; hence the word, "anodic treatment." This process forms an oxide film on the surface of the metal by electrolytic action, the reverse of plating, and this film has many desirable characteristics. While there seems to be some disagreement as to whether this film in itself offers any resistance to corrosion, many tests have indicated that this is the case. Regardless of this feature, the other qualities it possesses, therefore, even though no additional corrosion resistance is obtained from the film, the net conclusion regarding its usefulness remains the same. There have been experiments made, and they found out that where the metal has been exposed to the salt spray for a certain time, long enough to blister, the benzol-treated parts blistered, the paint came off in large blisters, and the sand blasted came off in small blisters, showing that it was a better adherence with the sand-blasted and the caustic-etched parts. But the anodized surface seems to resist this blistering more so than anything that they have come across yet. Of course, there is no paint that cannot be penetrated by water to some extent, and after the plate has been exposed to sea water, especially in tropical countries, and the water has penetrated through the paint film, and has attacked the aluminum, a certain oxidation goes on there, a chemical action, and forms these blisters. But the inert oxide formed by the anodic treatment seems to resist it quite successfully.

After it is anodized, the alloy sheets are given a coating of primer, iron oxide, and for under water work, or rather, surface plates, an aluminum bitumastic or enamel is used.

There is an ever-increasing use of aluminum in all aircraft work, and now they are making the wings out of aluminum alloy, the ribs, beams, and even the wing surface itself. If you have noticed any of these large tri-motored Fords, you will notice that the wings and fuselage and every part of the outside of the ship is made of corrugated dural. Even the propellers are made out of dural.

Of course, the development of aircraft has more or less been dependent upon the development of the metals directly concerned,

and the material directly concerned in it. There has been development along the line, the engines and plane structures have been improved, and flights have been longer, and records have been broken quite frequently, due more or less to the material involved and the engineering back of the plane structures and the engines themselves. Transoceanic flights were due. They were due to come sooner or later, because the development of engines brought increased confidence in a power plant. Lindbergh stimulated the imagination of the world when he cut across the Atlantic. Of course, he had a 200 horsepower Whirlwind Wright, weighing about 540 pounds, weighing 2.2 pounds per horsepower. If he wanted to do it today, he could avail himself of a Cyclone or Hornet, developing 570 horsepower, and only weighing 700 pounds, or about 1.2 pounds per horsepower. Of course, I doubt whether he would choose a high-powered motor today, figuring the flight from an economic standpoint, but he would have got there a whole lot quicker using a Cyclone or other high-powered motor.

There has been comparatively little progress made in wing design since 1927. All the curves had been worked out years ago, and they change but little. There has been a great deal of improvement in the shape of the wings and the design of the ship. But there has been plenty of progress in engines. The trend seems to be toward the radial motor. The radial air-cooled motor is quite an advantage over the water-cooled motor in some respects, because you don't have to put up with a leaky radiator, and due to the high vibration that you usually find around an aeroplane motor a radiator don't stand up very long; it springs leaks; the water line will develop leaks, and in a long flight these don't go over so good. It just means failure. There is one disadvantage, however, in the radial motor, because of the head resistance that is offered to the wind. A V-type or a line motor, where the cylinders stretch back in line, offers very little head resistance, particularly if they are stream lined. But a radial motor takes up so much room that it cuts down the speed of the ship on account of that resistance. Of course, they have developed the N. A. C. A. cowling for engines, and the Curtiss anti-drag ring, and these increase the speed about 20%.

There are other features, stream-lining the landing gear, the wheels, struts and so forth. Because if an object is going through the air, say in the direction of an air stream, that offers a certain amount of resistance to the air stream. The air flows past, it is

broken in the front and runs around the back of the object, and there are eddies set up in behind the objects, and it creates a vacuum there, and that holds back more so than the resistance that is offered in the front. In order to overcome that, they stream line everything that they can on a ship, so that the wind forms a very smooth stream back along the object, without cutting any eddies of any account, and that gives a free flowing air current.

You will notice on a lot of ships they have these pants; that is, the wheels are stream lined, and it gives the appearance of pants. The wires are stream lined, and they are developing retractable landing gears; that is, the landing gear can be folded up when the plane is in flight, and that adds considerably to the speed of the ship, because with that refinement it cuts down the head resistance. That air flow is taken advantage of all through the design of aeroplanes, and if anyone has ever put his hand out of a moving train or automobile traveling at a fair rate of speed he will notice that it takes considerable force to hold the hand there. And instead of that, if you would hold a flat plate made of some stiff material like wood, under similar conditions you would find that it would give quite a pressure. And this pressure would increase as the speed increases, and would also increase as the size of the plate was increased. If the plate were tilted toward the wind at an angle, you would find that, in addition to giving pressure, considerable lift would be exerted; that is, it would have a tendency to rise in the vertical. And this lift would increase materially as the speed increased and as the size of the plate increased.

In wing design, the usual type wing is made something like that. (Draws side view of aeroplane wing.) That is tilted at an angle of about two or three degrees, which is called the angle of incidence, and the air flowing past that airfoil develops a certain amount of lift, and this lift is usually about one-third past the entering edge of the wing. Not all of the lift is obtained under the wing, but it is that vacuum that is created above there that is responsible for that lift. For a long number of years everybody believed that the pressure of the air flowing underneath the wing developed the lift, but researches in the wind tunnel and so forth have brought out the fact that it is that vacuum above the wing that is responsible for quite a lot of the lift.

Wings are made in different shapes. You will find that the speedier ships have a very thin wing, and a very small angle of

incidence. The angle of incidence is the angle that the wing is tilted against the horizon. And racing planes have a very low angle of incidence, and they depend for their propulsion upon high-powered motors, and they are driven through the air at such a speed that they offer very little head resistance.

Now, a high load wing is shaped more like that. (Draws cross-section of thick wing.) The reason for the heavier section is because it allows for internal bracing to give it the necessary strength to carry high loads.

There are many different shapes of wings. (Draws flat view of aeroplane.) Now and then you will see a ship that has a wing section tapered down like that, at the tips of the wings. You will usually find that in a highly maneuverable ship, something like the Army pursuit ship, the Curtiss Hawk. The Curtiss Hawk is a ship that develops about 180 miles air speed, and it has to be a highly maneuverable ship because it has a lot of work to do. It doesn't depend altogether for its activity, or its function doesn't require altogether so much speed. Of course, the more speed the better. You have probably read of some of the aeroplane records that have been made, and they run up around 350 miles an hour. The British hold the record for seaplanes, and I think that is 357 miles an hour. And yet our Army pursuit ships only have a top speed of about 180 miles an hour. But the reason for that is that in a racing plane they have a very thin wing section, and a very low angle of incidence and a very low lift wing, and consequently their landing speed is very high, because there is nothing much to keep that ship in the air except its forward speed. There are no stability factors whatever to speak of, and in aeronautic design you can have a lot of speed if you want, but your other specifications suffer when you develop too much speed. That is, your stability factors have to be sacrificed, and your landing speed has to be sacrificed. And in an Army pursuit ship, where the combat zone in the theatre of operation is very seldom predetermined, they can't always pick an ideal landing field. They have got to take whatever is offered to them. And the usual run of landing fields are less than three or four thousand feet long. So a ship such as that which flew in the Schneider Cup races last October would require about a mile to land in, because it has to land at about one hundred miles an hour. There are other factors in the design of ships that make for stability. For instance, a thick wing will give high loading, but naturally it offers quite a lot of resistance

to the air flow, and naturally you have to sacrifice some speed there.

If you will notice, there are some ships, looking at them in the forward position, the wings take an angle like that. (Draws wide "V.") It is called the dihedral angle. That is a contributing factor towards the lateral stability of the ship. Sometimes you will find only the top wing with a dihedral angle, like this P. K. P. N. flying boat of the Navy. During the war we had some that had a reversed dihedral on the lower wing. That is all due to the whims of the designers. The designer has concrete ideas sometimes of just what he wants in a ship.

Another factor helping the stability of a ship is the "stagger." Looking at the ship from the side, you will notice on a lot of ships that the lower wing is set back from the upper wing something from fourteen to twenty-eight inches, depending on the design of the ship and the work that it has to do. This stagger contributes to the longitudinal stability of an aeroplane, and depending on the gap in between the wings is the efficiency of it. Because as the air flows past the upper airfoil there is a certain amount of disturbance there; and there is always a certain amount of disturbance above this lower wing, and if they both come in conjunction they mess in around there and it cuts down the efficiency of the ship. They also use stagger to increase the visibility of the ship in some military ships, and that is one of the reasons why some designers are going towards the monoplane. The monoplane seems to be quite popular at the present time. It seems to be increasing. But, if you will notice, all the ships where a high maneuverability is desired are of the biplane type. But that doesn't mean necessarily they will always be that way.

The wing loading, the pay load a ship will carry, depends on the wing surface that is offered to the air flow. So, naturally, in a biplane, you get twice as much wing surface as you do in a monoplane. Of course, you don't get twice the efficiency; the efficiency is cut down somewhat with a biplane, but you don't have the great wing spread that is necessary in a monoplane. Where it is desired to cut down for hangar space or some other reason the wing span, the designer will take advantage of a biplane.

In order to design a ship around a given engine with a minimum of dead weight and the maximum of useful load, at the same time fulfilling demands for strength in all structural members, he has to figure on just how much wing surface he needs, and if he can

make it in a monoplane so much the better, because the monoplane offers a simplicity of design and greater visibility than the biplane. And, if you will notice, most military ships are made of biplanes, mostly for the reason that they are more maneuverable. A military ship has to be extremely maneuverable. There are four different types of military ships; that is, the pursuit, the attack, observation, and bombing. The bombing planes, of course, are the heavy babies that go out and lay their eggs, and they carry heavy loads, and they have to be protected. That is, the design of ships at the present day do. I believe there is a ship now under construction which is a bomber and is capable of carrying a 1,000-pound bomb, and is quite mobile, maneuverable, and very fast, and the idea of the thing is to go out as a lone wolf, and destroy its objective, without having to be protected by the pursuit ships. The pursuit ships, naturally they protect the observation and the bombing and the attack ships; they fly at low altitudes and demoralize the enemy, with machine guns, and hold up their program by chasing them off the roads, destroying the roads, and so forth.

Most of the attack ships you see today have a sweep-back. That is, the wings, as you look at them downwards, have that pronounced sweep-back which is a contributing factor to the longitudinal stability. Because they have to dive from great heights and they have to carry quite a heavy armament.

In designing a ship, a great deal, of course, has to be put into the distribution of the weight, the center of gravity and the landing speed are governing factors. You will also notice, on the center of gravity, there are quite a few low wing monoplanes. The low wing monoplanes have the fuselage a little above the wing. In the high wing monoplane the weight of the fuselage is suspended below the wing, and, the lift being up, the weight hangs something like a parachute. That contributes quite a lot to the stability of the ship. Now, as you raise the fuselage above the wings, you cut down the stability of the ship, and you cut down the maneuverability of the ship. A low wing monoplane is quite stable, but still it is not quite so maneuverable. The trend today seems to be in the direction of a lot of these low wing monoplanes.

The high wing monoplane, where the center of gravity is low, is probably responsible for the autogiro. This Pitcairn autogiro has a low center of gravity because the windmills, the four blades that swing around, give a certain amount of lift. In fact, one of those

blades, in motion, gives about six times more lift than it would give when at rest. So that they don't have to have so wide a wing surface. They swing around there, and the lift is directly overhead, giving a very low center of gravity, and that is probably the reason why the autogiro can come down almost vertically. I never saw any of them take off vertically, but they seem to require just about as much room as the conventional type ship on the take-off.

In any design, the distribution of weight centers around three axes—that is, the lateral stability, the longitudinal stability, and directional stability. If those three factors are not stable, the ship will develop tendencies to spin. These tail spins are all right; they show you what a ship can do, they show you just how stable a ship is, they show you how strong a ship is, and sometimes there is a lot of fun in them. But sometimes a ship will spin just when you don't want it to, if the design is faulty. Of course, these days, you don't have any trouble that way. But back during the war, if you got one of those old Jennies up in the air a little bit, and got the nose up in the air a little bit, and with a little rudder on, she would turn right around and spin. And some of them are pretty hard to get out of it, especially a flat spin. But the way they make ships these days you don't have to worry about going into a spin.

I guess that's about all I can think of at the present time, except that the aircraft industry is looking forward with a great deal of confidence to the future. Naturally, they have suffered a great deal in the past, due to the prevailing depression, in common with other businesses, and in 1929 they anticipated a market for privately owned planes that just didn't materialize, but sooner or later they are going to develop a ship that is aerodynamically stable, refined; that is, it will be the ultimate in refinement, and they will be able to make it on a production basis, which they can't do at the present time. I don't say that they can't do it, but there isn't the market for it at the present time, and it wouldn't be very good business policy to go ahead.

But with these aluminum alloy stampings, it looks like there are great possibilities, because the wing ribs can be stamped out and assembled. If you take a wing rib, it is constructed something like this, the internal bracing there. (Draws sketch of interior of wing.) And the beams are usually I beams, and there are two beams in a wing. There is a forward or front beam and an aft beam. Now, these stringers, ribs, are laid across, are fastened to the beams or

spars, something like this (illustrates), and this naturally is trued up and checked for alignment, and the whole thing is covered with fabric, or it can be covered with an aluminum alloy sheet. There is a sheet called Alclad that the Aluminum Company of America has developed. The idea was to have something that would have high corrosion resisting properties, and that was found in aluminum. Aluminum will resist corrosion more so than the aluminum alloy. But the aluminum is very soft, so they combined the two, and they covered aluminum alloy with a very thin sheet of pure aluminum. That is, a sheet of aluminum alloy is sandwiched in between two thin sheets of aluminum, and they are using that for covering wings, fuselages, nacelles, and any parts that may come in contact with salt water, as in seaplanes, or that is exposed to any corrosion at all. The wings offer great possibilities in mass production, and they do stamp them out, they make these ribs of stampings. The spars could be fabricated easily enough on a production basis, and the whole ship slapped together in order to put out a job that would come within the reach of everybody. I guess it won't be much longer, and I don't know that everybody will be flying planes, but they will be at least within the reach of the average person, so that you at least can fly them or be able to travel on them economically.

Thank you.

(Applause)

CHAIRMAN SNYDER: Are there any questions?

MR. HIRSCH: I would like to know a little more about the heat treating.

MR. LYONS: The castings are not heat treated as much as the die castings and the wrought alloys. They are heated at 930 degrees F. Any temperature between 920 and 940 degrees F. Usually about 935. And they are annealed. I forgot to mention the annealing. The annealing is done at 670. That is held in the same time and taken out and quenched in water, and it stays soft indefinitely. There is a better way of annealing, by holding the temperature of the furnace at 800 degrees and letting the furnace cool, and letting the pieces cool in the furnace, in the salt bath; let them cool overnight. Then they reach their maximum softness, and even then they have trouble, that is, giving it too drastic treatment, because that stuff hardens up on cold working.

JOS. E. UNDERWOOD, *Secretary.*

ANDERSON BRANCH

As previously decided, the August meeting, August 4, 1931, was largely social, only a brief business meeting being held.

Starting at 4:30 p.m., members met at the Guide Lamp Club House, east of Anderson, and engaged in a game of playground baseball, the final score being 29-26 in favor of "our side." Following some horseshoe contests, etc., a Dutch lunch was served indoors.

After supper, a three-round boxing bout in the flyweight division was given by the Trout Brothers. The referee lost the decision.

In a short business session it was moved and passed that the Anderson Branch guarantee $2.00 per member as its contribution toward the Research Fund, in response to a letter from Mr. Gilbertson, which had been read. It was decided that a means of raising this money should be settled upon later.

A frantic appeal for back dues was made by the treasurer. Three dollars was collected.

Following this, a typical paper on "The Manufacture of Chromium Plated Parts" was read by Mr. Wagner.

MANUFACTURE OF CHROMIUM PLATED PARTS

By R. M. Wagner

An Ironical Talk Read at Anderson Branch Meeting.

The first step toward the manufacture of a plated product is naturally the design. This, of course, should be left entirely to the engineering department, which will make sure that there are plenty of deep recesses in the work, embossings where plate can be buffed through, and other handy little features, such as soldered liners, which will help make the plate peel off.

Once the article has been designed so that experts are sure it will be entirely impossible to plate, the next important step is the selection of stock. Whether the base metal be brass or steel, the purchasing department should have a free rein to purchase whatever they want. The stock selected by them will be of high quality, about 50% being sure to break in the draw presses, while the remainder will be full of huge pores and metal pits which will require at least three extra polishing operations to iron out. This will, of course, show a substantial material saving, and the assistant purchasing agent will get a raise for his efficiency. Meanwhile three foremen will go crazy, which will leave room for advancement.

In polishing any article, preparatory to plating it—as, for example, a headlamp shell—only operators showing great originality should be employed. Inspection standards should be set so as to require a minimum of 10 deep oil wheel marks and a maximum of

about 1500 on each shell. These may be arranged in concentric circles around the shell, but for best effect should be interwoven so that each shell has individuality. A clever operator will learn this trick in no time.

The next operation is color buffing. Of course, this is a mere formality and should not be taken too seriously. Some time ago it was rumored that there was going to be a "depression," and so this job was created in order to give more men employment and to keep manufacturing costs from becoming too low. A good color buffer will pick up practically every piece that comes to him and will touch at least 20% of them on the buff. This must be done lightly, however, in order not to remove any of the large chunks of compound or oil wheel designs which the polisher has left on the work. The article is now ready for plating.

In plating on an automatic conveyor, the first tank should be a cleaner about 15 feet long. There must be anode rods of copper properly connected to a generator, and steel anodes should be used. For best results, however, there should be no solution whatever in the tank. This set-up is called an electric "dry-cleaner," and has been found very effective in automatic units.

One of the principles of plating is that all work should be thoroughly rinsed between operations, and so the next tank on our set-up is a rinse. For the sake of consistency, however, this tank is also run dry.

As every plater knows, the purpose of a cleaner is to cause "cleaner marks" under the plate. This will insure the plate peeling off when it is out on the road, and will increase the business of the service department tremendously.

Since the "dry cleaner" does not leave any marks, a secondary cleaner is included for this purpose. A strongly alkaline solution should be used so that the brass will be well tarnished upon leaving the bath, and thus provide an excuse for the subsequent dips which are already there and therefore really should be used. A variety of colors ranging from blue to black can be obtained from this cleaner. A reverse current cleaner is provided after the secondary cleaner. However, this is never used, and should be kept full of soupy, stagnant water. This is followed by a rinse.

One principle should always be followed with rinses. Water should be run into them or changed at least once a year. This is necessary to prevent the spread of malaria among the personnel, as

the green scum on top becomes harmful when it gets over two inches thick.

Following the rinse, there should be a cyanide dip. This is included merely for the sake of precedent. Nobody has ever determined the exact reason for a cyanide dip. For the sake of variety, the concentration of the cyanide dip should be changed daily. For example, it should be run at ½ oz./gal. on Monday, 2 oz./gal. on Tuesday, an electric current placed on it on Wednesday, and the whole works dumped on Thursday. This serves to keep the control chemist on his toes—particularly when nobody informs him as to the intended change of conditions. A summary at the end of the week will show that there has been practically no difference in results from day to day.

Next comes another stagnant rinse, followed by an acid dip. The purpose of the acid dip is to try and undo the damage done by the cyanide dip, and also to congeal any particles of soap cleaner that remain on the work. This aids materially in getting that artistic "crackled" effect which is so much sought after in the nickel.

Another rinse, and then comes the nickel plating operation. This is very delicate. A current density of from 2 to 10,000 amps. per sq. ft. should be maintained; and the solution should be constantly agitated by dropping brass parts into it. Temperature should be checked every other Saturday. If these conditions are maintained and contact is broken at least three times during the plating cycle, a beautiful "stucco" finish is assured.

Nickel buffing is the next operation, and great care should be exercised in selecting nickel buffers. The first qualification is that they must be good baseball players. This will keep the plant's standing high in the commercial Twilight League. Second, they should be chronically dissatisfied and must always complain about the hardness of the plate. Third, they must have tough toes and shin bones. At least half of the surface of each part should be nickel-colored. The rest does not matter, as of course chromium plate covers up all defects and a few gray spots serve to set off the lustre of the rest of the piece anyhow.

The chromium bath is the most important of all, as it always provides a nick loophole for plating experts who want to tell you what is wrong with your work. If you are using a 24 oz./gal. solution, the big shot from New York will arrive and tell you that you should be using 55 oz./gal. and a lower sulphate ratio. He will

then leave town on urgent business before you can try his suggestion out. The next day while you are trying his 55 oz. solution, another big shot will arrive from Detroit and tell you that you should be using 33 oz./per gal. and that anyhow your sulphate ratio should be higher. He will then use a lot of big words which he cannot explain, tell about the new solution he has developed for use in a two quart tank in the laboratory and then he too will leave town on urgent business. When you find that his solution is worse than any of the others you've tried, you return to your original solution, which you will now find works perfectly.

Chrome tank temperature should be maintained accurately between 50° and 200° F., and the solution should be kept at a "soupy" consistency by continually dissolving parts in it. Hammers and wrenches dropped in by maintenance men are particularly beneficial; and if the operator will learn to chew tobacco and spit in the chrome tank, a much higher lustre will be obtained on the work.

It has recently become fashionable for large plating establishments to have a chemist and a laboratory. Of course, in a plant where production seldom goes over 1,500,000 plated parts in any one day, such a set-up is entirely unnecessary and is used only to provide atmosphere. When taking a sample of solution to the laboratory always be sure you have a nice dirty bottle. Make no attempt to get a fair sample and remember that if you accidentally sample the solution next to the one you are interested in, the laboratory analysis will be practically the same anyhow. Remember that accuracy really doesn't count. Speed is all that matters, so always be in a hurry. All the chemist has to do anyhow is to measure out three fingers of yellow stuff into a beaker, look thoughtful and write down a result. He has an easy, irresponsible life.

If the foregoing instructions are carefully carried out, it is guaranteed that work will come out of your chrome tank with a variety of beautiful finishes, ranging from rainbow to Christmas tree effects. All that is now necessary is to send the work to the strip tank and start it through process again. A meeting of all plating foremen will then be called to discuss the trouble. At 6:30 p.m. this meeting will break up, after all matters including the depression and the cost of work shirts at J. C. Penny's have been discussed. You will then go home, full of enthusiasm over your

day's work; and the following morning the control chemist will be fired for failure to maintain the chrome solution at the proper concentration.

The meeting then officially adjourned.

The July 6 meeting was called to order at 8 p. m. with 24 members and guests present. All officers were present.

Minutes of last previous meeting were read and approved, as was a financial report on the Banquet.

Two communications from Mr. Gilbertson were read. Two letters from Mr. Mertz of the Indianapolis Branch, relative to the disbanding of that branch and the desire of the members to affiliate with us, were read. Mr. Cleaver explained this situation and advised that no action should be taken until we heard from the Supreme Society.

The treasurer made another appeal for dues, which netted $1.50 in cash.

Mr. Cleaver presented the Supreme Society's suggestion that a contribution of $2 per man be made to the Research Fund. No action was taken on this. It was moved by Mr. Wagner and passed that the next meeting should be a social session held at the Guide Lamp Club House. Mr. Cleaver announced that he would appoint a committee later for this.

Reports on the Convention were heard from Messrs. Cleaver, Kaegi and Cotton.

Mr. Wagner gave a talk on the "Measurement of pH in Nickel Baths," describing and illustrating the most common methods. A discussion of the theory and practical use of the Quinhydrone Electrode was included.

Mr. Cleaver then inquired as to what pH was being used in nickel plating in the various plants represented. A variety of answers was received. Mr. Props exhibited some brake levers he had plated, using a current density of 975 amps. per square foot in the copper, and 525 amps. per square foot in the nickel. These, he said, were quite easily buffed.

Mr. Whipple told of experiments using 100% nickel anodes for plating.

Following some more discussion, the meeting adjourned at 10 p. m.

R. M. WAGNER, *Secretary-Treasurer.*

NEWARK BRANCH

The regular meeting of the Newark Branch, the first to be held in their new meeting quarters at the Elks' Club, Newark, N. J.

Due to the absence of President Harrison who is on his vacation, Vice-President A. Fletcher conducted the meeting.

The Vice-President called the meeting to order at 8:45 p. m. with an attendance of 26 members.

Report of delegates to the convention was heard and Newark Branch was again honored in having Mr. Philip Sievering elected Supreme President of the A. E. S. Supreme President Sievering spoke of the convention at Rochester and a splendid time was had by all who attended. Mr. Oliver

Sizelove summarized the convention papers and problems presented and visit to the plants and their features.

Newark Branch held its annual fishing trip to Forked River, August 15, 1931.

Under good and welfare the Question Box was again in progress, and the following questions were asked:

A method of producing olive green on brass?

What brighteners are used in brass solutions beside arsenic?

What is a good metal content for bronze solutions? Give % zinc, % copper.

What is a good free cyanide content for the bronze solution, 95-5?

Can it be run successfully, that is to an even color, without the addition of arsenic?

Can spotting out be cured in bronze solution.

Meeting adjourned at 11:15 p. m.

GEORGE REUTER, *Secretary.*

DAYTON BRANCH

The regular monthly meeting of Dayton Branch, American Electro-Platers Society, was held Saturday evening, August 1, at the home of our fellow member, Mr. Clarence Folz, 2830 Salem Ave.

The meeting was called to order by our president, Mr. Cusick. The minutes of the previous meeting were read and so approved. Other business of the Branch included a communication from Mr. Sievering. Plans for the chemical control class to be conducted this winter, and remarks by our President in regard to the efficient methods of our class instructor, Mr. Suman, and his story about the dog set us in the right mood for the round table discussion that was to follow, for it was truly that.

Perhaps it was the atmosphere of the home, where, as individuals, we discuss our problems with our families, that brought about such a wonderful meeting, for we were truly as one family, discussing our problems with one another, and as platers we realized that "no man liveth unto himself alone," but that we are all dependent on one another.

The more we attend these meetings and hear the discussions, the more we realize the great amount of good that comes from them, and we certainly owe it to ourselves and our Society to take an active part, for it is through the exchange of ideas that we progress.

This meeting was one that will long be remembered and talked about in the future; and we are indeed fortunate in having a member who is so vitally interested in the Society as to turn his home over to us for our meeting.

Dayton Branch extends its sincerest thanks to Mr. and Mrs. Folz for their kindness in having us there, and especially to Mrs. Folz for the fine lunch (for we feel she was responsible for it), and also for her patience in tolerating a gang of platers.

This idea of meeting at the home of one of our members is not copyrighted, and if any of the several branches are in need of some sort of a stimulant to

arouse interest in the Society we ask them to try it. Surround your members with the atmosphere of home and you will find that those who rarely take part in the discussions, when the meetings are held in some hotel room, will talk freely in these environments.

WARD PROTSMAN, *Recording Secretary.*

ROCHESTER BRANCH

On Friday evening, July 17, Rochester Branch held their monthly meeting and elected officers for the coming year, the election being put over until the July meeting on account of convention held in Rochester this year. The following persons were chosen:

President, Wm. D. Hart; Vice-President, J. R. Elster; Secretary-Treasurer, Chas. Griffin; Board of Managers, S. P. Gartland, F. J. Kohlmeier, G. A. Lux; Librarian, Clarence Feilds. Messrs. Elster, Lux and Kohlmeier were elected a committee to select a place for our annual clambake in September. The following applications were received: John H. Jordan, Rochester, N. Y.; Joseph C. Nowak, Buffalo, N. Y.; LeRoy A. Dockstader, Utica, N. Y.

CHAS. GRIFFIN, *Secretary.*

Annual Family Outing
and Clambake
at THE OLD HOMESTEAD *on*
IRONDEQUOIT BAY
Saturday, September 19th
SPORTS FOR ALL

Rochester Branch invites all A. E. S. members and their friends who are in this vicinity to attend. Remember the date and try to be with us.

Reservations may be made with

CHAS. GRIFFIN,
24 Garson Ave., Rochester, N. Y.

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held August 8, 1931, at the Atlantic Hotel.

The meeting was called to order with President J. C. Kretschmer presiding. All other officers present.

Owing to the very warm evening, the routine of business was carried off as quickly as possible.

We had the pleasure of receiving two new applications for active membership:

Mr. C. H. B. ley, Rock Island Mfg. Co., Rock Island, Ill.; Mr. George Nagel, 317 Eighth Street, Rockford, Ill.

The business part of the meeting was taken care of.

The meeting was turned over to the librarian, Mr. O. E. Servis, and the following questions were found in the box:

Question—If an article is plated in nickel sol. for 20 min., then current is shut off for 1 hour and current is again applied, will there be two deposits on the article, or will the second deposit amalgamate with first deposit?

Answer—This caused some lively discussion. All members took part. Some members thought it depends on the character of solution. This question was laid over until our next meeting in September.

Question—What is the most suitable dip for lead before nickel plating work is afterwards chrome plated?

Answer—Use dip consisting of hydrofluosilicic acid H_2. S_1. F_6. 5 per cent solution or hydrofluoboric H_2. B. F_6. 5 per cent sol. Clean parts with calcium carbonate.

Question—What is a good soaking sol. to use on cold roll steel to remove heavy oil?

Answer—Low deetars soap and hot caustic sol. No current.

Question—Is depolarized nickel anode better to use than 99% plus fully annealed nickel anode? Anodes to be used in hot nickel sol. conveyor type.

Answer—Both are suitable, providing P. H. are kept right.

Question—A nickel sol. contains lead deposit plates bright and brittle P. H. 6. What can be done to such a sol. to make deposit good again so chromium can be deposited thereon?

Answer—Add sulphuric acid, then neutralize with ammonia or carbonate of nickel. Heat up sol. and then cool.

Question—What is the best method to remove the black paint or lacquer from name plates made of brass?

Answer—Any good cleaning solvents or a good elec. cleaner will remove very easily.

E. G. STENBERG, *Secretary and Treasurer.*

Mr. S. E. Hedden, 227 Fifth St., Aspinwall, Pa., has been appointed by President Sievering as our official representative to the American Society for Testing Materials.

APPLICATIONS

CLARENCE H. BAILEY, R. I. Mfg. Co., Rock Island, Ill. (Active).....Chicago
GEORGE ALBERT NAGEL, 317 Eighth St., Rockford, Ill. (Active).....Chicago
THOS. F. O'CONNER, 1884 Lake View Ave., Rocky River, O. (Active) Cleveland
J. S. NACHMAN, 408 Belvedere Ave., S. E., Warren, O. (Assoc.)....Cleveland
MEIRL C. WAY, 36 S. Munn Ave., E. Orange, N. J. (Assoc.).....New Jersey
BENJAMIN MINKEN, 1944 75th Street, Brooklyn, N. Y. (Active)....New York
RALPH WELBURY, 675 Garden St., Harrison, N. J. (Assoc.).....New Jersey

ELECTIONS

ROBT. W. SHAFFER, 7308 34th Ave., Kenosha, Wis.....Milwaukee

SUSPENSIONS

EDGAR FREEMAN, 144 Valley Ave., N. W., Grand Rapids.....Grand Rapids
NIC GERKE, 644 S. 5th Street, Milwaukee, Wis.....Milwaukee
CHAS. UNKE, 481 65th Ave., West Allis, Wis.....Milwaukee

JUST A BOY

Got to understand the lad—
He's not eager to be bad;
If the right he always knew,
He would be as old as you.
Were he now exceeding wise,
He'd be just about your size;
When he does things that annoy,
Don't forget—he's just a boy.

Could he know and understand,
He would need no guiding hand;
But he's young and hasn't learned
How life's corners must be turned.
Doesn't know from day to day
There is more in life than play,
More to face than selfish joy,
Don't forget—he's just a boy.

Being just a boy he'll do
Much you will not want him to;
He'll be careless of his ways,
Have his disobedient days.
Wilful, wild and headstrong, too,
Things of value he'll destroy,
But reflect,—he's just a boy.

Just a boy who needs a friend,
Patient, kindly to the end;
Needs a father who will show
Him the things he wants to know.
Take him with you when you walk,
Listen when he wants to talk,
His companionship enjoy.
Don't forget—he's just a boy!

—*Anonymous.*

DEEP STUFF

JUST KEEP PEGGING AWAY

Waiting for something to happen;
Waiting and wondering why
Nothing comes just when you want it;
Watching the clouds cross the sky,
Waiting for "Luck's" welcome visit,
Waiting for dull skies to clear,
Spending long hours in just waiting
Hopelessly crying, "Oh, dear!"
That's not the way to kill trouble,
That's not the road to success,
Work!—and look smilingly upward,
Throw away gloom and distress.
Life's a grand game—be a sportsman;
Make up your mind as you play—
Nothing can stop you from winning
If you only keep "pegging away."

—E. TRACEY ARCHER.

SEA DOGS

Senator Dill, on the way home from Europe, said at a Coney Island luncheon:

"'You'll find lots of quaint old sea dogs on the New England coast.

"A minister went to Gloucester to take charge of a church during July and August, and one Sunday afternoon down on the wharf he introduced a couple of sea dogs to each other.

"'Capt. Backstay, this is Capt. Marlinspike. You probably saw each other in church this morning.'

"'Aye, aye,' said Backstay heartily. 'He was sleepin' in the bunk next to mine.'"

A member of Dayton Branch sends this one:

A MULE

Maybe you'll get the same sort of a "kick" out of the following that we did:

A Mule Can't Pull When He Kicks,
And He Can't Kick When He Pulls.
Neither Can You or I.

—*Exchange.*

CONGRATULATIONS ALL ROUND

In some offices the clerks, upon arrival in the morning, have to sign their names in an "attendance book." This book provides space for signature, time of arrival, and "remarks."

Ten minutes after the hour an official draws a red line under the last arrival's name, and all those coming subsequently are expected to furnish an explanation of their tardiness in the "remarks" column.

When a real fog—one of London's "particulars"—occurs, the number below the line is legion. The first of them writes, "Delayed by fog," and the rest scribble "ditto."

One morning, a foggy one, Mr. Jones became a proud father, but even this only caused him to be eleven minutes late. Proudly he wrote in explanation, "Wife had twins," and this was followed in due course by the usual string of "dittos."

A certain laird of the manor had an old servant whom he allowed many liberties. One day the laird noticed Auld Donald writing in a small notebook.

"What have you there, Donald?" he inquired.

"I'm making a list o' the biggest fools I know," was the reply.

"O! And is my name on the list?"

"Aye, that 'tis."

"Come, come, Donald. This is past bearing! Why am I on your list?"

"Weel, last week ye sent Angus doon to Lunnon to buy horses for ye, an' gave him a thousand pounds; an' ye took no receivt for neathin'."

"But come, come! I know Angus well. I need no receipt from him. He'll be back."

"Weel, if he comes back I'll scratch your name off and write his in its place."

—*Providence Journal.*

RESEARCH COMMITTEE

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Other Branch Representatives will be printed as received.

ANDERSON BRANCH

Meets first Monday of every month at 7:30 p.m. at the Anderson Indiana Y. M. C. A. R. M. Wagner, Secretary-Treasurer, 28 W. 12th St., Anderson, Indiana.

BALTIMORE-WASHINGTON

Meets in Enoch Pratt Library, Calhoun and Hollis Sts., Irvin H. Hahn, Secretary, 207 S. Sharp St., Baltimore, Maryland.

BOSTON

Meets at American House, Boston, Mass. First Thursday each month. Secretary A. W. Garrett, 45 King St., Dorchester, Mass.

BRIDGEPORT

Meets first and third Friday of each month at Chamber of Commerce Rooms, Stratfield Hotel. Secretary, T. H. Chamberlain, 889 Orange St., New Haven, Conn.

CHICAGO

Meets second Saturday of each month, at 8 p. m., Atlantic Hotel, 316 S. Clark St., Secretary, E. G. Stenberg, 2200 N. Kenneth Ave., Chicago, Ill.

CINCINNATI

Meets every Thursday, 7:30 p. m., at Vocational Training School, Spring and Liberty Sts. Secretary, Al Yenger, 3021 Sherman Ave., Norwood, Ohio.

CLEVELAND

Meets first Saturday of each month at Hotel Winton, Paul R. Stamm, Secretary, 947 Elbon Road, Cleveland Heights, Ohio.

DAYTON

Meets first Saturday of each month at the Y. M. C. A., Dayton, Ohio. Secretary, Ward Protsman, 141 Westwood Ave., Dayton, Ohio.

DETROIT

Meets the first Friday of each month at the Hotel Statler, Louis II Room. Secretary, Chas. M. Phillips, 18933 Hickory Ave., Detroit, Mich.

GRAND RAPIDS

Meets second Friday of each month at 820 Lake Michigan Drive, N. W. Secretary, Jacob Van Dyke, 1361 Union Ave., N. E., Grand Rapids, Mich.

HARTFORD-CONNECTICUT VALLEY

Meets fourth Monday in each month alternately at the Chamber of Commerce 815 Main St., Hartford and the Chamber of Commerce 134 Chestnut St., Springfield. Secretary, Vernon Grant, 32 Jennings Road, Bristol, Conn.

INDIANAPOLIS

Meets second Saturday of each month at Hotel Denison. Secretary, Louis Mertz, 1725 Union St., Indianapolis, Ind.

LOS ANGELES

Meets second Wednesday of each month at the Chamber of Commerce Bldg., 9th floor, 1151 S. Broadway. Secretary, M. D. Ryukoff, 1554 W. 25th St., Los Angeles, Calif.

MILWAUKEE

Meets second and fourth Thursdays of each month at Cor. 3rd and Highland Ave., Frank J. Marx, 1431 W. Cherry St., Milwaukee, Wis.

MONTREAL

Meets second and fourth Friday of each month at 1437 Aylmer St. Montreal, Quebec, Canada, where the Secy-Treas. Mr. Charles Doherty, can be found at any time.

NEWARK

Meets first and third Fridays of each month at Franklin Hall, 41 Franklin St., Newark, N. J., at 8 p. m. Secretary-Treasurer, Geo. Rueter, P. O. Box 201, Newark, N. J.

NEW YORK

Meets second and fourth Fridays of each month in the World Building, Park Row, New York City, N. Y. Secretary-Treasurer, J. R. Sterling, 2331 46th St., Astoria, L. I.

PHILADELPHIA

Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary, J. E. Underwood, 827 N 19th St., Camden, N. J.

PITTSBURGH

Meets first Friday of each month at 8 p. m., at downtown branch, Y. M. C. A. Secretary, S. B. Hodden, 227 Fifth St., Aspinwall, Pa.

PROVIDENCE-ATTLEBORO

Meets first and third Thursday of each month at 44 Washington St., Prov. Engineers Rooms, Providence, R. I. Secretary, J. H. Andrews, 19 Rosedale St., Providence, R. I.

ROCHESTER

Meets third Friday of each month at Hotel Seneca. Secretary, Chas. Griffin, 94 Garson Ave., Rochester, N. Y.

SAN FRANCISCO BRANCH

Meets at Plaza Hotel, San Francisco. Secretary, H. W. McKibben, 310 Tehama St., San Francisco, Cal.

ST. LOUIS

Meets second Friday of each month at the Plant of the Lasalco Co., 2925 LaSalle St. Secretary, C. T. McGinley, 8214 Fairham Ave., University City, Mo.

TOLEDO

Meets first Thursday of each month at Toledo Secor Hotel, Cherry and Page Sts. James M. Lee, Secretary, Harbor Street, Fremont, Ohio.

TORONTO

Meets fourth Monday of each month at Canadian Foresters' Hall, 22 College St., Room No. 2. Secretary, H. W. Graham, 101 Robina Ave., Toronto, Canada.

WATERBURY

Meets second Friday of the month at Engineers Hall, No. 11 East Main Street. Wm. F. Guilfoile, Secretary, P. O. Box 961, Waterbury, Conn.

WORCESTER

Meets Directors' Room, Chamber of Commerce, Worcester, Mass. Roger H. Bryant, Secretary, 94 Grove St., Worcester, Mass.